REMARKS

The Examiner Thanh T. Nguyen is thanked for carefully examining and reviewing the subject Patent Application. With entry of this response to the Office Action, claims 23 - 27 are considered to be in condition for allowance.

In earlier office actions, claims 1 - 22 have been canceled by the Applicant, and non-elected claims 28 - 41 have been withdrawn and canceled, reference Applicant's office action response, October 2002.

Claim 1 has been amended to better represent the Applicant's Claimed invention.

CLAIMS REJECTIONS - 35 USC 103:

Reconsideration of the rejection of Claims 23, 25 and 27 under 35 U.S.C. 103(a), as being unpatentable over Jeng et al. (U.S. Patent No. 6,114,186) in view of Lucas et al. (U. S. Patent No. 6,287,951), is requested, based on the following.

There are patentable differences between the Prior Art cited and the Applicant's invention, namely the following.

The Applicant's curing conditions are not, as taught by Jeng:
" 300 ^{0}C by a hot plate bake ... ". Jeng (col. 4, lines 39-42);
Applicant's amended Claim 23, states low dielectric material curing at 400 ^{0}C.
Also, the Applicant states in amended Claim 23, that silicon nitride is both an adhesion promoter and stabilizing material, not taught in Jeng.

The Applicant's stabilizing material is not, as taught by Jeng:
"by plasmas with a thickness of about 1,000-3,000A" Jeng (col. 4, lines 42-60)

Jeng teaches layer #20, "cap layer", or inter-dielectric layer to be comprised of silicon dioxide. This is a key patentable difference from that of the Applicant's disclosure.

The Applicant's invention teaches the following stabilizing material:

The Applicant's dependent Claim 25 discloses that the method of independent Claim 23, for the layer of adhesion promoter and stabilizer is: a non-oxide compound.

"26. The method of claim 25, wherein said layer of adhesion promoter and stabilizer is silicon nitride, deposited by plasma enhanced chemical vapor deposition to a thickness of between about 200 and 500 Angstroms."

As stated above, the Applicant's invention teaches PE CVD, as the specific deposition method for the adhesion/stabilizer SiN layer, and thickness range differs from the prior art. Therefore, the prior art neither teaches nor suggests the Applicant's method.

The Applicant's cap silicon oxide is not:
"cap silicon oxide layer (22) by PECVD with a thickness about 16,000 A".

The Applicant's invention teaches a cap silicon oxide:
Claim 27 depends on independent Claim 23, and states
",wherein said silicon oxide cap layer is deposited by plasma enhanced chemical vapor deposition, to a thickness of between about 4,000 to 16,000 Angstroms."

In sharp contrast, Jeng et al. teaches, in Col. 4 line 61, "The cap layer 20 may be followed by a thick, about 16,000 A, SiO_2, interlayer dielectric 22...".

Furthermore, Jeng's teachings have significant differences from that of the Applicant, ref. Jeng, Col. 4 lines 54 and 55, "The thickness of the cap layer is preferably about 1,000 to 3,000 A, and most preferably about 2,000 A."

Lucas et al. (U. S. Patent No. 6,287,951), primarily teaches forming a hardmask and an antireflective layer with silicon nitride, with a totally different application than that taught by the Applicant's Invention. The placement in the process for the "Lucas' nitride", is not to be used as a "stabilizer and adhesion

promoter" on low dielectric material, as is taught by the Applicant's invention; thus, demonstrating patentable differences. The Lucas disclosure neither teaches nor suggests, the Applicant's claimed invention.

Reconsideration of the rejection of Claim 24 under 35 U.S.C. 103(a), as being unpatentable over Jeng et al. (U.S. Patent No. 6,114,186) in view of Lucas et al. (U. S. Patent No. 6,287,951), as applied to claims 23, 25, 27, further in view of You et al (U.S Patent No. 6,197,703) is requested, based on the following.

Jeng does not teaches that the SiN layer is only used as a stabilizing layer, but fails to teach that the silicon nitride layer can also be used as an adhesion promoter as well.

The Applicant's curing conditions are not, as taught by Jeng:

" 300 ^{0}C by a hot plate bake ... ". Jeng (col. 4, lines 39-42).

Jeng in view of Lucas does not teach the following low dielectric curing conditions, as found in the Applicant's Claim 24.

In contrast, the Applicant's invention teaches the following curing conditions:

Claim 24 depends on independent Claim 23, and states, "wherein said low dielectric constant material is spun on dielectric, deposited to a thickness of about 4,000 to 12,000 Angstroms, with curing conditions at 400°C for 1 hr., in a nitrogen ambient gas flow from about 1 to 30 SLM, oxygen less than 10 ppm."

Jeng et al. '186 in view of Lucas above, do not specifically show the curing conditions above, as taught by the Applicant's claimed invention.

Furthermore, both Jeng et al. '186 and You et al (U.S Patent No. 6,197,703), neither teach, nor suggest the Applicant's claimed invention. The above prior art are primarily concerned with processing HSQ material. There exist patentable differences from the Applicant's teaching in the above Claim 24, "low dielectric constant material is spun on dielectric." The Applicant's Claims do not mention, nor teach an HSQ process, nor an HSQ method. The reference "You", does teach and disclose in detail, equipment and process details relating to HSQ insulating layers; but, the Applicant's claimed invention does not teach,

nor claim to have invented: the disclosed HSQ material, equipment, or processing.

Finally, commenting on the "You" reference again, Figs. 1-2, layer 26 is SiN sandwiched in between two layers of HSQ; but, the Applicant's figures contain patentable differences from that of "You". The "You" reference teaches SiN in between multi-level wiring layers, consisting of single layers of insulator. The Applicant's claimed invention teaches SiN in between a bi-level layer of low "k", dielectric layers, with the purpose of stabilizing and aiding adhesion between the bi-level layers of insulator, in the same wiring level, which is not the same as in the "You" Figs. 1 and 2.

Reconsideration of the rejection of Claim 26 under 35 U.S.C. 103(a), as being unpatentable over Jeng et al. (U.S. Patent No. 6,114,186) in view of Lucas et al. (U. S. Patent No. 6,287,951), as applied to claims 23, 25, 27, further in view of Jeng et al (U.S Patent No. 5,818,111) is requested, based on the following.

Jeng ('186, '111) in view of Lucas, does not disclose the thickness of the SiN layer between 200-500 A, Applicant's Claim 26. Jeng ('186, '111) teaches the stabilizing layer #20 to be silicon dioxide, which is preferred for low-k silicate dielectrics.

The Applicant teaches (Claim 25) that the layer of adhesion promoter and stabilizer is: a non-oxide compound. Furthermore, Applicant's Claim 26, dependent on Claim 25, "wherein said layer of adhesion promoter and stabilizer is silicon nitride, deposited by plasma enhanced chemical vapor deposition to a thickness of between about 200 and 500 Angstroms."

As stated above, the Applicant's invention teaches a non-oxide compound, deposited by PE CVD, as the specific deposition method for the adhesion/stabilizer SiN layer, with a thickness range that differs from the prior art. Therefore, the prior art neither teaches nor suggests the Applicant's method.

A question of obviousness of the Applicant's claimed invention has been raised in connection with the prior art presented, and it is related to the use of nitride as a protection layer over HSQ. The material HSQ is never mentioned either in the Applicant's Specifications, or in the Applicant's Claims. Most of the Prior Art cited by the Examiner is concerned with processing HSQ material. These are patentable differences between what is taught by the prior art and what is taught by Applicant's Claims 23, 25 - 27.

In conclusion, for state-of-the-art advanced applications in silicon technology, the applicant's invention is believed to be patentable over these various references, because there seems to be insufficient basis for concluding that the modification of Prior Art disclosures, Jeng, Lucas and You, would have been obvious to one skilled in the art. That is to say, there must be something in the prior art or line of reasoning to suggest that the combination of these various references is desirable. We believe that there is no such basis for the combination. Please see the Applicant's Invention Summary for key differences and key advantages of the Applicant's claimed invention.

SUMMARY OF THE INVENTION

It is the general object of the present invention to provide an improved method of fabricating semiconductor integrated circuit devices, specifically by describing an improved process of fabricating multilevel metal structures using low dielectric constant materials. The present invention relates to an improved processing method for stable and planar inter-metal dielectrics, with low dielectric constants. A method is described which utilizes a stabilizing adhesion layer between a bottom, low dielectric constant layer and a top dielectric layer. The advantages are:

(i) Improved adhesion and stability of the low dielectric layer and the top dielectric oxide;

(ii) Thickness of the dielectric layers can be reduced, hence lowering the parasitic capacitance of these layers.

FINAL REMARK

The Examiner Thanh T. Nguyen is thanked again for carefully examining and reviewing the subject Patent Application. With entry of this response to the Office Action, all claims are now considered to be in condition for allowance.

All rejected claims 23 - 27 are now believed to be in allowable condition, and allowance is so requested.

It is requested that should there be any problems with this response to the Office Action, please call the undersigned Attorney at (845) 452-5863.

Respectfully submitted,

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